The Genus *Lernæodiscus* (F. Müller, 1862).

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(Plate 38.)

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The genus *Lernæodiscus* was created by F. Müller in 1862 (1) for a Rhizocephalous parasite found by him on a *Porcellana* from Brazil. He did not describe the internal anatomy of the parasite, and nothing more was known about it until I gave an account of the genus in my Monograph of the Rhizocephala in 1906 (2), based on some specimens found on *Galathea dispersa* at Naples, on *G. intermedia* from Norway, and on *G. strigosa* from Naples. Since the appearance of this work two French authors have added to our knowledge of the genus, Dr. Max Kollmann (3 & 4) and Dr. Guérin-Ganivet (5). These authors have accepted the account I gave of the anatomy, but Dr. Kollmann disagrees with my interpretation of the orientation of the parasite and offers a different one.

The re-examination of the question which is here undertaken is due to Professor W. A. Herdman, who found a specimen of Rhizocephala upon a *Munida bamffica* from the Shetlands and sent it to me for identification. I had previously seen two Rhizocephalous parasites on *Munida*, and described them as a new genus *Triangulus* in my monograph (2, p. 115) ; but since I was only able to study these two specimens (which were not very well preserved) macroscopically, I was in considerable doubt as to the correctness of my diagnosis. I was anxious therefore to study Professor Herdman's specimen by means of serial sections, which he very kindly permitted me to do, and the result of this examination has been to show that this parasite of *Munida* really agrees in all essentials with the *Lernæodiscus* on *Galathea* and should be included in that genus. The genus *Triangulus* must therefore be withdrawn, and the parasites hitherto described as *Triangulus munidæ* should be named *Lernæodiscus munidæ*.

At the same time a careful examination of Professor Herdman's specimen and a re-examination of my preparations of *Lernæodiscus galatheæ*, have shown that I have made an error in my description and figure published in my monograph with regard to the position of one of the genital openings. This error certainly led me astray in the interpretation I put upon the orientation of the parasite, and I have now no doubt that Dr Kollmann's correction of my interpretation is amply justified, and that his own view is essentially right.

It is hoped, therefore, that in this paper the anatomy and systematics of the Rhizocephala hitherto found on the symmetrical Anomura may be

put straight, and the peculiar orientation of the parasites satisfactorily cleared up.

The specimen of *Lernæodiscus munidæ* (= *Triangulus munidæ*) found by Professor Herdman is figured from two aspects on Pl. 38. figs. 1 & 2. The surface on which the mantle-opening (*op.*) is situated (fig. 1) is applied to the thorax of the *Munida* when the tail is bent in its natural situation ; the surface depicted in fig. 2 is applied to the abdomen of the host. The peduncle (*p.*) by which attachment is effected is in a deep excavation of the body, and the mantle is thrown into several pronounced folds. The mantle-opening is asymmetrically placed on the lower right-hand corner, as shown in fig. 1, *op.* The only other features which can be observed from the outside are the broad surface of the mesentery (*m.r.*, fig. 1), which passes from the peduncle to the opening, and the much narrower hinge of the mesentery (*m.l.*, fig. 2) upon the other side.

In my previous account of *Lernæodiscus* these two hinges of the mesentery were called anterior and posterior hinges respectively, as it was my view that the long axis of the body passed through the long axis of the mesentery, but this is incorrect, as Kollmann has shown, and we should call the longer mesentery, passing from peduncle to near the opening, the right mesentery, and the smaller mesentery on the other side the left.

The disposition of the internal organs is shown in the diagrams figs. 3 & 4. In fig. 3, which is a transparent diagram of fig. 1, it is seen that the openings of the testes are situated one on each hinge of the mesentery, the right testis (*r.t.*) upon the edge of the large mesentery, the left testis (*l.t.*) upon that of the small mesentery behind. Both testis-ducts open backwards into the half of the mantle-cavity turned away from the mantle-opening. The mistake which was made in my earlier account of *Lernæodiscus* consisted in figuring the left testis as opening on that edge of the left mesentery which is turned towards the mantle-opening, and in the opposite direction to the duct and opening of the right testis. The position of the testis-openings shows that the left-hand part of fig. 3 is morphologically posterior and the right-hand part anterior, while the mid-dorsal axis passes through the peduncle at right angles to the long axis of the mesentery. The nerve-ganglion (*n.*) is situated on the large right mesentery, and the two oviducal openings are placed on the visceral mass on either side of the mantle-opening.

Fig. 4 is a diagrammatic view looking down on the peduncle and on to the mesenterial or dorsal side of the animal. Here is seen the smaller left portion of the mesentery and the larger right portion stretching to near the mantle-opening. The two testes are seen opening posteriorly to right and left of the peduncle. The nerve-ganglion (*n.*) and the two oviducal openings are seen situated on or near the right expansion of the mesentery.

Before going on to explain the peculiar asymmetrical disposition of these organs, a comparison may be made between this condition in *L. munidæ* and

the arrangement in *L. galatheæ*. Corrected diagrams of the anatomy of the latter are given in figs. 5 and 6. It will be seen from these diagrams that the positions of the testis-openings are the same as in *L. munidæ*, and not as I originally figured them in my monograph (2, Pl. 7. fig. 33). The nerve-ganglion is similarly situated on the large right mesentery, though a little further away from the mantle-opening than in *L. munidæ*. The two oviducal openings, one on each mesentery, are decidedly further away from the mantle-opening than in *L. munidæ*, and are also more definitely on the mesenterial edge and not on the wall of the visceral mass as in *L. munidæ*. How much importance is to be attached to these differences cannot be definitely stated, as the greater or less distension of the visceral mass might account to some extent for the shifting in position.

Another point of difference between *L. munidæ* and *L. galatheæ* is that in the former all the specimens hitherto obtained have the mantle-opening very definitely situated in an asymmetrical position on the right anterior corner of the body, while in *L. galatheæ* this opening is sometimes situated medianly or else deflected to the right anterior corner to a less extent than in *L. munidæ*. The fact that in *L. galatheæ* the position is variable and sometimes practically the same as in *L. munidæ*, should make one hesitate before attaching much importance to this slight point of difference.

In explaining the peculiar orientation of this parasite it is necessary to bear in mind the orientation of a more normal member of the Rhizocephala, and for this purpose *Peltogaster* may be chosen because its relations of symmetry are very simple. Fig. 7 is a diagram of the mesentery of *Peltogaster* viewed from the peduncular surface, or surface of attachment. This surface, as I have shown elsewhere (2), is the dorsal surface. The median axis of the body passes through the line AB, A being anterior and B posterior. The mantle-opening (*op.*) is seen at the anterior end of the mesentery, and the peduncle (*p.*) is seen piercing the mesentery somewhat toward its posterior end. The nerve-ganglion (*n.*) is seen on the anterior portion of the mesentery, and the genital openings are distributed on each side of the mesentery, the oviducal openings being in front and the testicular openings behind. The openings of the left side are a little in advance of those on the right side.

The way in which *Lernæodiscus* can be derived from this symmetrical condition is shown in fig. 8. Here the original long axis passes through AB, and the testes still occupy their original position, but the mesentery has been expanded laterally, especially on the right side, and the anterior portion of the mesentery in front of the peduncle has been rotated to the right, so as to be nearly at right angles to the original long axis AB. The position of the nerve-ganglion, of the oviducal openings, and of the mantle-opening relatively to the testes and the peduncle, clearly show that this rotation has taken place.

It will be seen from this account that I fully agree with Dr. Max Kollmann's conception as to the correct orientation of the parasite, according to which the surfaces applied to the host are respectively right and left, and the two hinges of the mesentery are called right and left in correspondence. But the unfortunate mistake which I made in describing the testicular openings has obscured from Dr. Kollmann the rotatory movement of the mesentery which has resulted in bringing some of the anterior organs, viz., the nerve-ganglion, mantle-opening, and one or both oviducts, on to the right side. Dr. Kollmann believes that it is easier to derive *Lernæodiscus* from *Sacculina* or *Heterosaccus* than from *Peltogaster*. As a matter of fact, this does not influence the correct orientation of the parasite, since *Sacculina* is easily derived from *Peltogaster* or *vice versa*, the organs being disposed symmetrically in relation to the mesentery in both these genera. The peculiar thing about *Sacculina* is that the symmetry of the parasite does not correspond to that of the host, the mesenterial or dorsal side of the parasite being always on the morphologically right side of the host's long axis. It has always seemed to me a curious fact that this should be so, and I am still further puzzled by the hypothesis that *Sacculina* on infecting the symmetrical Anomura should have given rise to a form like *Lernæodiscus*, which has acquired a totally different symmetry both in its own structure and in its relation to the host. As I originally pointed out, if we derive all these forms from a *Peltogaster*-like genus parasitic on the Asymmetrical Pagurids, we can understand that on infecting symmetrical forms of Anomura or Brachyura, the relation of symmetry to the host might very well undergo marked and various changes. The argument however is almost purely speculative, and does not influence our views as to the correct orientation of our parasites.

We may resume our account of the genus and species of *Lernæodiscus* as follows :—

Genus Lernæodiscus (*F. Müller* (1)).

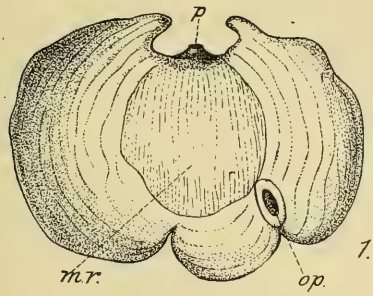
Diagnosis. External body of adult yellow.

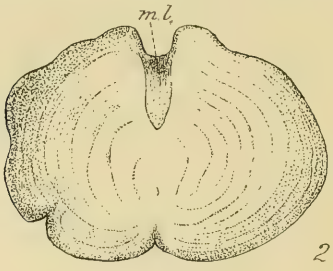
Roots yellow, widely distributed and ramifying, without lagenæ.

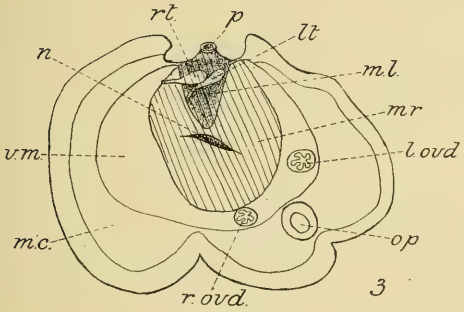
Mantle highly muscular, and thrown into lappets or folds to a greater or less extent.

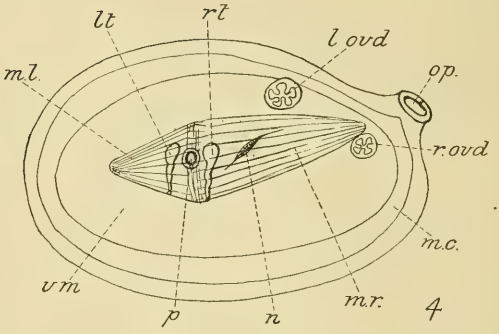
Mantle-opening situated either in the middle line or more usually deflected to the right side, relatively to the host.

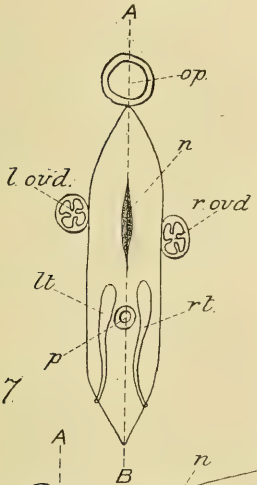
Mesentery broad, pierced by the peduncle, which separates two hinges; the morphologically right hinge being applied to the thoracic surface, the left hinge to the abdominal surface, of the host. The long axis of the parasite has undergone a peculiar rotation, which has resulted in bringing the nerve-ganglion and mantle-opening on to the right hinge of the mesentery (see figs. 7 & 8).

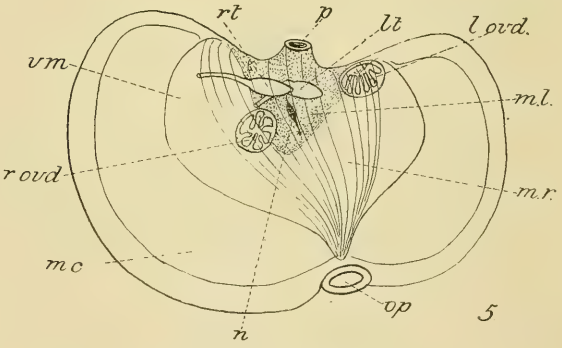


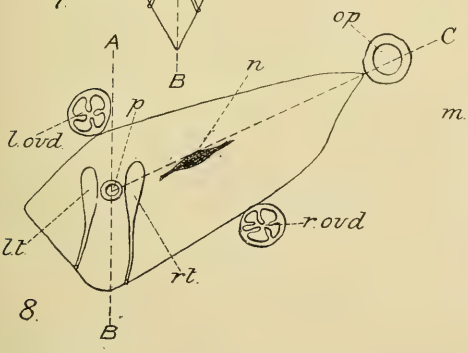


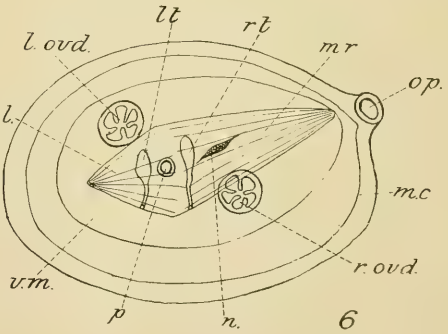












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LERNAEODISCUS, *F. Muell.*

Colleteric glands (oviducts) paired and convoluted.

Genital openings asymmetrically distributed owing to rotation of mesentery (see figs. 3, 4, 5, 6, 7, 8.)

Nauplius with somewhat elongated and curved frontal horns.

Parasitic on Symmetrical Decapoda Anomura.

L. PORCELLANÆ, *F. Müller* (1). Host: *Porcellana* sp. from Brazil.

Visceral mass purplish, lappets of mantle very conspicuous and indented.

L. GALATHEÆ (*G. W. Smith* (2)). Hosts: *Galathea dispersa* at Naples (Smith (2)), Gulf of Gascony (Guérin-Ganivet (5)).

Galathea intermedia, Norway (Smith (2)), Saint Vaast-la-Hougue and Gulf of Gascony (Guérin-Ganivet (5)), Banyals (Kollmann (3 & 4)).

Visceral mass yellow; lappets of mantle few and irregular.

L. STRIGOSÆ. Host: *Galathea strigosa* at Naples (Smith (2)).

Distinguished from above only by larger size, and may probably be included under *L. galatheæ*.

L. MUNIDÆ (=*Triangulus munidæ* (G. W. Smith (2)). Hosts: *Munida bamffica* from Norway (Smith (2)), and from the Shetlands (Professor W. A. Herdman). Gulf of Gascony and Brittany coasts, and African coast, south of Cape Bojador (Guérin-Ganivet (5)).

Visceral mass yellow. Lappets of mantle few and deeply indented. Mantle-opening deflected very definitely to right side. Colleteric glands (= oviducts) advanced well on to visceral mass in neighbourhood of mantle-opening. Relations of mantle and of openings of testes and of nerve-ganglion the same as in *L. galatheæ*.

Note.—It is clear from the meagre distinctions which it is possible to make between these various parasites attached to different Galatheids that it is very doubtful how far they represent good species. It is, indeed, doubtful what criterion of a good species there can be in animals which reproduce by a continuous round of self-fertilization, and are only distinguished from one another by slight differences of shape and sometimes of colour, and which offer no morphological features of outstanding importance in which they differ. I have already dealt with this fundamental difficulty in my monograph (2) pp. 166 & 167.

Literature.

1. F. Müller.—Arch. f. Naturg. 28 Jahrg., p. 5. 1862.
2. G. W. Smith.—The Rhizocephala. Naples Monograph 29, p. 114. 1906.
3. M. Kollmann.—Arch. Zool. Exp. et Gén. (5), t. i. Notes et Rev., pp. xlvi–xlvii. 1909.
4. M. Kollmann.—Annales des Sciences Naturelles, 9_{me} sér. t. x. p. 255. 1909.
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EXPLANATION OF PLATE 38.

Fig 1. *Lernæodiscus munidæ.* View from right side which is applied to thorax of host, *Munida bamffica.* × 2.

2. Ditto. Viewed from left side. × 2.
3. *L. munidæ,* viewed by transparency from right side.
4. *L. munidæ,* viewed from peduncular or dorsal aspect.
5. *L. galatheæ,* viewed by transparency from right side.
6. *L. galatheæ,* viewed from peduncular or dorsal aspect.
7. Diagram of mesentery of *Peltogaster* from peduncular or dorsal aspect. AB is median longitudinal axis.
8. Diagram of mesentery of *Lernæodiscus* from dorsal aspect, showing rotation of anterior half of mesentery to right side and shifting of axis to C.

Lettering :—*p.*, peduncle of attachment; *op.*, mantle-opening; *n.*, nerve; *r.ovd.*, right oviduct; *l.ovd.*, left oviduct; *r.t.*, right testis; *l.t.*, left testis; *m.c.*, mantle-cavity; *v.m.*, visceral mass; *mr.*, right mesentery; *m.l.*, left mesentery.